

UNITED STATES DEPARTMENT OF THE INTERIOR  
MINERALS MANAGEMENT SERVICE  
GULF OF MEXICO REGION

# ACCIDENT INVESTIGATION REPORT

1. OCCURRED

DATE: 08-JUL-2005 TIME: 1525 HOURS

2. OPERATOR: BP Exploration & Production Inc.

REPRESENTATIVE: Anne-Renee Laplante

TELEPHONE: (281) 366-5455

CONTRACTOR:

REPRESENTATIVE: None

TELEPHONE:

3. OPERATOR/CONTRACTOR REPRESENTATIVE/SUPERVISOR  
ON SITE AT TIME OF INCIDENT:

None

4. LEASE: G09868

AREA: MC LATITUDE:  
BLOCK: 778 LONGITUDE:

5. PLATFORM: A(Thunder Horse)

RIG NAME:

6. ACTIVITY: ☐ EXPLORATION (POE)  
☒ DEVELOPMENT/PRODUCTION  
(DOCD/POD)

7. TYPE:

- ☐ HISTORIC INJURY
- ☐ REQUIRED EVACUATION
  - ☐ LTA (1-3 days)
  - ☐ LTA (>3 days)
  - ☐ RW/JT (1-3 days)
  - ☐ RW/JT (>3 days)
  - ☐ Other Injury

- ☐ FATALITY 0
- ☐ POLLUTION
- ☐ FIRE
- ☐ EXPLOSION

- LWC ☐ HISTORIC BLOWOUT
- ☐ UNDERGROUND
  - ☐ SURFACE
  - ☐ DEVERTER
  - ☐ SURFACE EQUIPMENT FAILURE OR PROCEDURES

COLLISION ☐ HISTORIC ☐ >\$25K ☐ <=\$25K

- ☐ STRUCTURAL DAMAGE
- ☐ CRANE
- ☐ OTHER LIFTING DEVICE
- ☐ DAMAGED/DISABLED SAFETY SYS.
- ☒ INCIDENT >\$25K 16 degree listing of vessel
- ☐ H2S/15MIN./20PPM
- ☐ REQUIRED MUSTER
- ☒ SHUTDOWN FROM GAS RELEASE
- ☐ OTHER Ballast Control Failure

6. OPERATION:

- ☐ PRODUCTION
- ☐ DRILLING
- ☐ WORKOVER
- ☐ COMPLETION
- ☐ HELICOPTER
- ☐ MOTOR VESSEL
- ☐ PIPELINE SEGMENT NO.
- ☒ OTHER Commissioning

8. CAUSE:

- ☐ EQUIPMENT FAILURE
- ☒ HUMAN ERROR
- ☐ EXTERNAL DAMAGE
- ☐ SLIP/TRIP/FALL
- ☒ WEATHER RELATED
- ☐ LEAK
- ☐ UPSET H2O TREATING
- ☐ OVERBOARD DRILLING FLUID
- ☒ OTHER Hurricane Dennis

9. WATER DEPTH: 6400 FT.

10. DISTANCE FROM SHORE: MI.

11. WIND DIRECTION:  
SPEED: M.P.H.

12. CURRENT DIRECTION:  
SPEED: M.P.H.

13. SEA STATE: FT.

## 17. INVESTIGATION FINDINGS:

Findings indicate that personnel were instructed to isolate the four hydraulic power units (HPUs) that control the ballast control valves as part of the evacuation process. The HPUs are manufactured by Danfoss Marine Systems. The process (procedure) by which the personnel isolate the HPUs is based on "on-the-job" experience from previous job assignments on other deepwater operations projects. BP did not have a formal written procedure specific to the isolation of the HPUs. Shortly after the isolation of all four HPUs immediately prior to evacuation, a significant number of vessel monitoring system (VMS) alarms were captured, indicating multiple valve movements. Recorded data indicates that over 80 ballast and bilge valves experienced movement. On August 7, 2005, a test was conducted on two of the four HPUs to replicate the isolated condition in which they were left on evacuation. This demonstrated that the isolation was not effective and that the HPUs were still capable of providing sufficient hydraulic power to cause the 80+ bilge and ballast valves to open gradually from their initially closed positions. Further investigation reveals that BP did not conduct a hazards operability (HAZOP) review of this system during the design stage. Also, BP officials stated that if they had conducted a HAZOP review, they probably would not have looked at this scenario because the system was purchased from the manufacturer as a complete system. BP also did not confer with the HPU manufacturer to identify hazards created by improper operation of the HPU system.

Evidence from the ballast tank inventories (pre evacuation and post incident) indicates that water migration occurred from a number of ballast tanks, most importantly from the starboard forward column tanks, into other tanks and spaces in different quadrants of the hull. The two column ballast tanks, which were known to be full immediately prior to evacuation, were found to be empty after re-boarding. The elevation of the column tanks is approximately 40 meters above the keel. This elevation would provide sufficient hydrostatic head pressure to cause water migration through partially opened valves.

Three check valves in the bilge piping system were found to be installed in the wrong position, and one additional check valve was found to be inoperable.

There were a number of multiple cable transits (MCTs) failures in the bulkhead that were discovered during the re-boarding and assessment of the hull. MCTs are the points in the watertight bulkheads where cables that carry electrical power and instrument signals pass through the watertight bulkheads. Essentially, MCTs are molded blocks of plastic that seal around each cable. Failure occurred in the spaces filled with blank blocks. Further investigation into the MCTs revealed that the MCTs were improperly installed for the configurations they were being used for. The direction of failure indicated the direction of water flow through the transits. The MCTs are manufactured by MCT Brattberg of Sweden.

It is calculated that about 15,000 metric tons of seawater entered the hull during the event. However, inspection of the hull, both above and below the water line, has not revealed any evidence of a breach. Additionally, inspection and testing of all engineered penetrations in the hull below the normal water line (instrument ports, sea chests, etc.) have failed to uncover evidence of a leak.

The PDQ was to be equipped with remote monitoring and operation capabilities of the ballast control system prior to commissioning of the vessel. However, this equipment was not operational at the time the vessel left the shipyard, nor was it operational at the time of the evacuation for Hurricane Dennis. On Friday, July 8, 2005, personnel began evacuation procedures in preparation of Hurricane Dennis. According to the onboard vessel monitoring system (VMS), shortly after all personnel were evacuated, the PDQ began listing to the starboard side for approximately six hours before starting back to the port side. The PDQ continued to list to the port side to approximately 16 degrees. When the PDQ was discovered on Monday, July 11, 2005, the PDQ was listing at approximately 20 degrees.

18. LIST THE PROBABLE CAUSE(S) OF ACCIDENT:

Findings indicate that failures associated with the hydraulic control system and its isolation on evacuation led to the partial opening of multiple hydraulically actuated valves in the ballast and bilge systems of the vessel. This allowed ballast water migration to take place, causing the initial listing (to approximately 16 degrees) of the vessel shortly after the hydraulic system was isolated.

The findings also indicate that ballast water migrated into manned spaces in the lower hull, via faulty and improperly installed check valves in the integrated ballast/bilge piping system. As the degree of list increased beyond the 16 degree mark, downflooding of seawater occurred, initially through overboard discharge lines and/or vents, and possibly later through the deck box as it entered the water. Since the PDQ was already listing at a 16 degree angle prior to the passage of Hurricane Dennis, wave action associated with the passage of the hurricane may also have contributed to the downflooding of seawater.

Although not an initiating event, failed Multiple Cable Transits (MCTs) and two unintended openings in the bulkheads allowed water transfer between watertight compartments, which led to extensive flooding and water damage in the lower hull.

19. LIST THE CONTRIBUTING CAUSE(S) OF ACCIDENT:

The failure of BP, the operator, to develop standard operating procedures for the isolation of the Danfoss HPUs to be used during evacuation is considered a possible contributing cause of the event. Further, the failure of the operator to perform a HAZOP review of the Danfoss HPU system and/or inquire from the manufacturer as to possible hazards created from the improper operation of the HPU system is also considered a possible contributing cause of the event.

The failure of the operator to conduct onsite verification inspections during the installation phase of the multiple cable transits is also considered a possible contributing cause. The failure of the MCTs increased the severity of the event.

The failure of the operator to have remote monitoring and operation capabilities of the ballast control system prior to evacuation is also considered a possible contributing cause of the event. If this system had been operational at the time of evacuation, the HPUs may not have been isolated and the ballast control could have been remotely monitored and controlled from a land location.

20. LIST THE ADDITIONAL INFORMATION:

21. PROPERTY DAMAGED:

NATURE OF DAMAGE:

Lower Hull compartments, deck box, ROVs, miscellaneous topsides damages, electrical systems      Flooding, missing or destroyed equipment.

ESTIMATED AMOUNT (TOTAL):      \$100,000,000

22. RECOMMENDATIONS TO PREVENT RECCURANCE NARRATIVE:  
These recommendations are made to the Minerals Management Service.  
MMS in conjunction with the USCG should:
1. Conduct inspections of MCT boxes to ensure proper installation.
  2. Conduct inspection/surveys of all bulkhead penetrations to ensure proper isolation.
  3. Conduct inspections/surveys of all potential downflooding points and weather/water tight barriers.
  4. Conduct an engineering and operations HAZOP review/study (similar to the PSS review) of the hydraulic, bilge and ballast systems for proper operation and isolation. This review should include a review of evacuation procedures for isolating all systems and a witnessing of test of the evacuation procedures.
  5. Require the remote monitoring/operation of the ballast control system prior to vessel(s) leaving shipyard.
  6. Require critical operation and contingency plans for curtailment of operations and storm-readiness capabilities during the installation period of the new/future facilities. (Atlantis, Gomez, Independence Hub, etc.)

These tasks should be completed prior to MMS issuing final acceptance of the CVA report and prior to the USCG issuing the Certificate of Inspection (COI).

23. POSSIBLE OCS VIOLATIONS RELATED TO ACCIDENT: **NO**
24. SPECIFY VIOLATIONS DIRECTLY OR INDIRECTLY CONTRIBUTING. NARRATIVE:

25. DATE OF ONSITE INVESTIGATION:

**11-JUL-2005**

26. ONSITE TEAM MEMBERS:

**David Dykes, MMS GOM Region / LCDR  
Andy Sheffield, USCG MSO Morgan  
City /**

29. ACCIDENT INVESTIGATION  
PANEL FORMED: **NO**

OCS REPORT:

30. DISTRICT SUPERVISOR:

**J. David Dykes**

APPROVED

DATE: **01-JAN-2007**

